U. S. NAVAL TECHNICAL MISSION TO JAPAN
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RESTRICTED

From: Chief, Naval Technical Mission to Japan.
To : Chief of Naval Operations.

Subject: Target Report - Power Supplies for Japanese Electronics.

Reference: (a)"Intelligence Targets Japan" (DNI) of 4 Sept. 1945.

1. Subject report, covering Target E-15 of Fascicle E-1 of reference (a), is submitted herewith.

2. The investigation of the target and the target report were accomplished by Lieut. P.D. Lacy, USNR.

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POWER SUPPLIES FOR JAPANESE ELECTRONICS

"INTELLIGENCE TARGETS JAPAN" (DNI) OF 4 SEPT. 1945

FASCICLE E-1, TARGET E-15

JANUARY 1946

U.S. NAVAL TECHNICAL MISSION TO JAPAN

SUMMARY

ELECTRONICS TARGETS

POWER SUPPLIES FOR JAPANESE ELECTRONICS

Japanese power supply component design remained static through the war years. The only marked change was a severe reduction in quality due to scarcity of required raw materials, and a decrease in the unit efficiency of a highly expanded production field.

There was a lack of integration of production design of power supply units in the overall equipment design, due to the extreme security measures taken by the Japanese Navy and Army. For example, the naval arsenal responsible for production of an electronic unit would supply specifications to a factory, often bypassing the entire engineering structure of the company. The factory would then produce and deliver the unit to the arsenal. Naval acceptance specifications were very loose and usually were left up to the factory. Later, the arsenal would incorporate the power supply unit into the final equipment. In addition, failure to remedy faults found in the field hindered coordination of equipment design.

TABLE OF CONTENTS

REFERENCES

Location of Target:

1. Second Naval Technical Institute, Tokyo Branch, MEGURO.
2. Dengen Kogyo Company Ltd., TOKYO.
3. Tokyo Shibaura Denki, K.K., TOKYO.

Japanese Personnel Interviewed:

1. Vice Admiral S. NAWA and Staff, Second Naval Technical Institute, MEGURO.
2. Mr. HAMADA, Laboratory Director, and Staff, Tokyo Shibaura Denki.

LIST OF ENCLOSURES

LIST OF ILLUSTRATIONS

INTRODUCTION

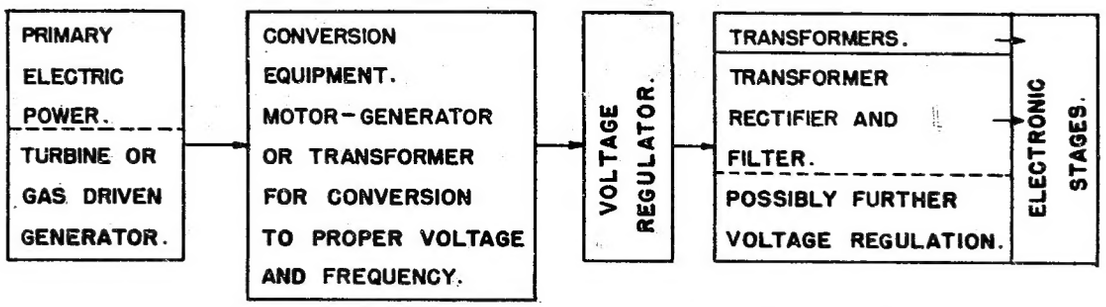
This report describes the findings of an investigation of power supplies for naval electronic equipment. The material has been largely obtained in interviews with Japanese technical naval personnel and engineers engaged in power supply design and production.

The absence of statistical data both on tests performed in connection with design and production, and on the operation and maintenance of power supplies, has necessitated restricting the scope of the report to a qualitative discussion. However, representative pieces of equipment have been shipped to the Naval Research Laboratory for further analysis.

THE REPORT

A. GENERAL

The purpose of this report is to describe and show the relative position of power supply units furnished with Japanese naval electronic equipment. In this report, a breakdown of power supply equipment has been made in accordance with the block diagram, Figure 1.



BLOCK DIAGRAM OF POWER UNITS ASSOCIATED WITH ELECTRONIC EQUIPMENT

FIG. 1

All types of naval power supply equipment, in surface and underwater vessels, in shore use, and in aircraft, will be discussed, with shipboard equipment receiving primary emphasis.

B. PRIMARY ELECTRIC POWER SOURCES

1. Shipboard Power. The usual electric power sources found on surface vessels are:

> 220 volts - 60 cycles - 3 phase, 440 volts - 60 cycles - 3 phase, and 220 volts direct current. The more modern vessels used alternating current, but many of the vessels supplied direct current. Further information on shipboard supplies is available in NavTechJap Report "Characteristics of Japanese Naval Vessels, Article 5 - Shipboard Electrical Equipment", Index No. S-01-5.

Electrical regulation aboard ship was poor. Voltage regulators and manual voltage adjustments were necessary, and even with those precautions frequent poor performance and some equipment failures were directly traceable to poor voltage regulation. The actual extent of voltage and frequency variation usually was unknown to the development and production agencies.

The primary power source on submarines was 220 volts at 500 cycles. The 500-cycle frequency was originally adopted to provide tone modulation for keyed radio transmitters.

The electric power for electronic equipment on army vessels was supplied by a gasoline generator. Each set of equipment was supplied with its own separate generator.

2. Aircraft Power. Electric power on aircraft was furnished by a 12-volt direct-current gasoline-driven generator. However, a change to a 400-cycle generator had been contemplated. Aircraft generators and motors received more

than usual attention in design and construction. Workmanship was best in the rotating electrical equipment field. Aluminum frames were used throughout most of the war; however, toward the end, the shortage of aluminum necessitated the use of cast iron frames.

3. Power for Land-Based Equipment. Land-based electronic installations used power from standard distribution systems where available. In addition, diesel-driven generators were supplied for emergency use, or for use when distributed power was not available.

C. CONVERSION EQUIPMENT

Shipboard. Ships having 220-volt direct current supply used a motor-generator set for conversion to alternating current. For radar use, usually a five or seven KVA generator was furnished. Japanese electrical rotating equipment design remained static during the war; the equipment was bulky and heavy. The scarcity of insulating materials caused shifts to low grade paper for wire and lead insulation. Seven KVA generators were constructed on 10 KVA frames, since the low quality insulation used could not accomodate the higher heat rise of a five KVA frame. No weatherproof or splashproof models were used, all such rotating equipment being in closed spaces aboard ship.

Line transformers were of conventional design. Performance specifications were as low as possible or completely overlooked. Inexperienced production plants and lack of raw materials caused continual decline in quality during the war years.

D. VOLTAGE REGULATION

1. Shipboard. Radar equipment usually required voltage regulation aboard ship. NavTechJap documents numbered ND-21-6103 (ATIS No. 3690), and ND-21-6105 (ATIS No. 3356) describe typical voltage regulators. Both are of the saturable core transformer type. The specifications are:

a. Input: 220 volts plus or minus 10%, 3 phase, and 50 to 60 cycles.
Output: 220 volts plus or minus 1 to 3% at 2.5 KVA.

b. Input: 220 volts plus or minus 10%, 3 phase, and 50 to 60 cycles.
Output: 220 volts plus or minus 1.5% at 5 KVA.

2. Land-Based. Radar equipment ashore usually had only manual voltage regulation. Exceptions to this were: a. 10 - centimeter radars for surface search and b. voltage regulation for certain units of searchlight control and gun-laying radars. The indicator unit had a vacuum tube type voltage regulator capable of regulation to less than 1% variation.

3. Aircraft. Most aircraft electronic equipment was provided with only manual regulation. In the late stages of the war, a vibrating reed type was made available. This regulator was similar to the 1933 Eclipse regulator.

E. INTRA-EQUIPMENT POWER SUPPLIES

This section considers only the filament and high voltage supplies, including added voltage regulation in direct current voltage supplies. A discussion of the components involved is contained in NavTechJap Report "Japanese Radio, Radar and Sonar Equipment", Index No. E-17. The design of the supplies was conventional and was furnished to the manufacturer by the naval arsenal responsible for the overall equipment production. The equipment was produced and delivered to the arsenal for final assembly. Further information may be obtained from the Japanese Naval Equipment Instruction Books and equipments being obtained for shipment to the United States. These items are tabulated in NavTechJap Report "Japanese Submarine and Shipborne Radar", Index No. E-01, and "Japanese Land-Based Radar", Index No. E-03.

F. SELENIUM RECTIFIERS

Selenium rectifiers, the production of which began about ten years ago in JAPAN, have completely supplanted the copper oxide types. War time production approximated two million units per month, of which about 800,000 were manufactured by the Dengen Kogyo Company.

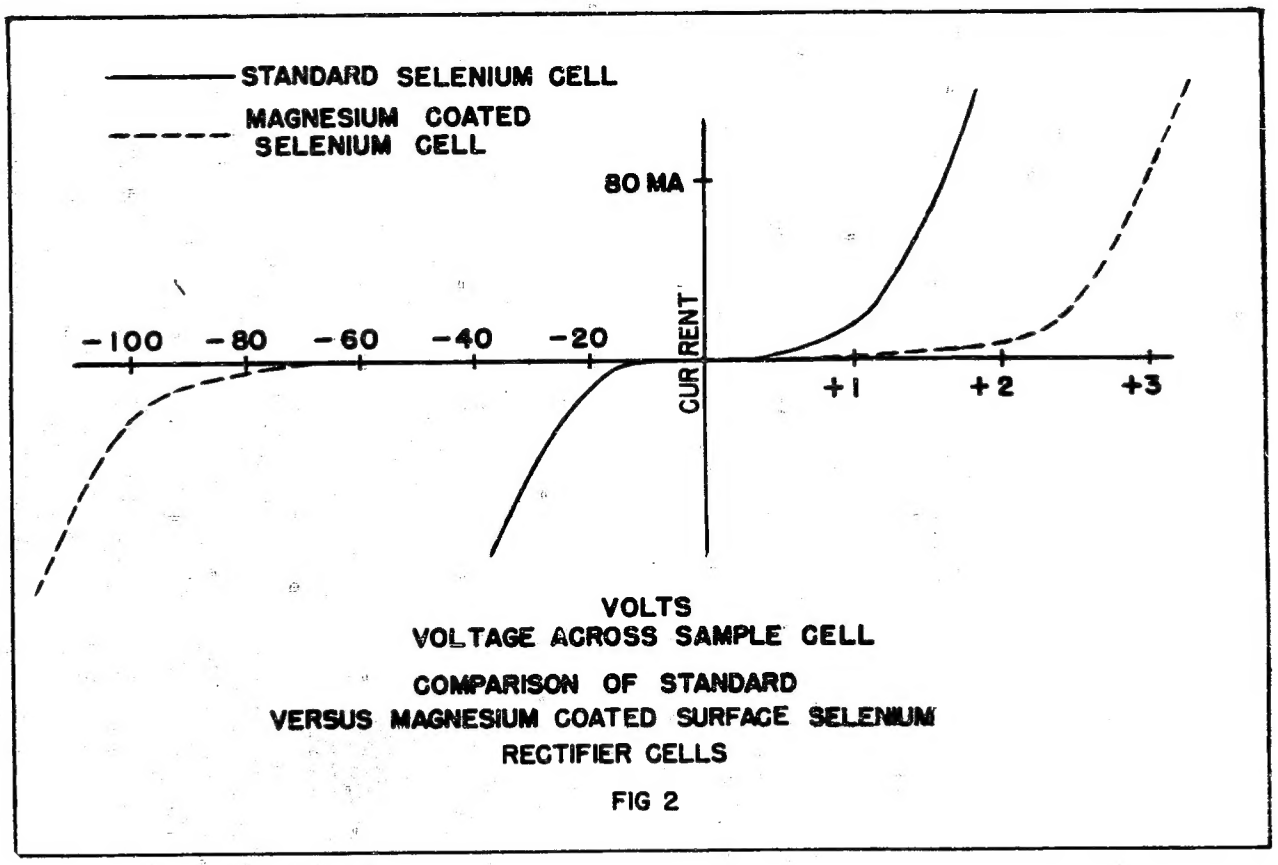
In the electronics field, selenium rectifiers were used extensively in land-based radio transmitters and in some shipboard radio and radar equipment and were coming into wide usage in aircraft equipment.

The following units were in large scale production:

Disc Diameter (mm)	Number of Elements	Maximum Voltage (volts)	Maximum Current (Milli-amperes)
10	63	500	2
18	50	400	60
45	30	250	800
80	20	150	2,500

(The 10 and 18mm units are enclosed in bakelite tubing with overall lengths of 150 and 1800mm respectively.)

The use of a magnesium coating on the selenium contact surface had been initiated. The resulting improvement is illustrated in Figure 2.



COMPARISON OF STANDARD VERSUS MAGNESIUM COATED SURFACE SELENIUM RECTIFIER CELLS

FIG 2

ENCLOSURE (A)

DOCUMENTS FORWARDED THROUGH ATIS TO THE WASHINGTON DOCUMENT CENTER

NavTechJap No.	ATIS No.	Title
ND-21-6103	3690	Instruction book: 2 KVA automatic voltage regulator.
ND-21-6105	3356	Instruction book: 5 KVA automatic voltage regulator, manufactured by HITACHI Company.